

# Highly Integrated Terahertz Receiver for Small Satellite Remote Sensing

Completed Technology Project (2016 - 2018)



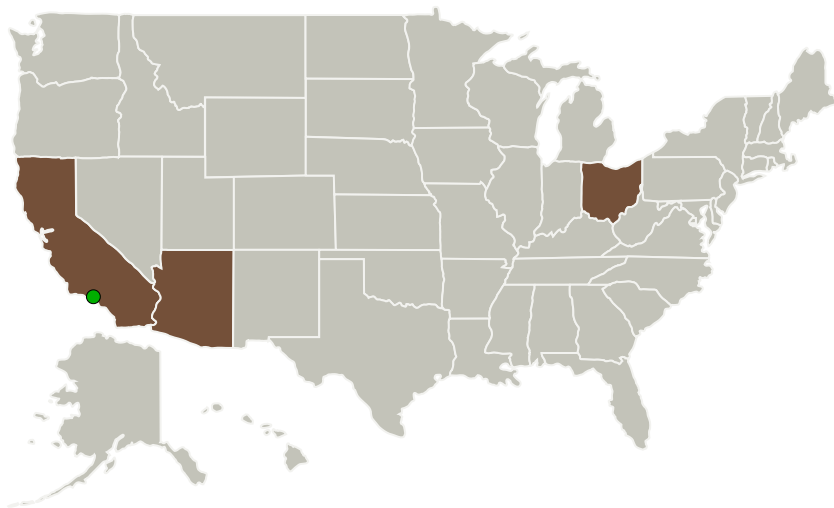
## Project Introduction

Water and atomic oxygen render Earth's atmosphere opaque in most of the terahertz (THz) band, but those very species are of intense interest to astrophysicists, planetary scientists and Earth scientists. This project will advance the state of the art Schottky diode receiver technology to develop THz receivers suitable for CubeSats. Micromachining will be used to repackage state of the art modular receivers into integrated systems that will reduce both mass and volume by more than an order of magnitude while preserving signal to noise performance.

## Anticipated Benefits

Several scientific applications in astrophysics, planetary science, and Earth observing that could take advantage of Schottky receiver systems if they could be reduced in size and mass sufficiently to fly on a CubeSat. One primary motivation for all three scientific areas involves the detection of water vapor. Water vapor lines at 557 GHz and in the 1100-1200 GHz bands are excellent diagnostics of water vapor in the interstellar medium, the Earth's atmosphere, and in the atmospheres of other planetary bodies.

## Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Arizona State University-Tempe(ASU)	Lead Organization	Academia Alaska Native and Native Hawaiian Serving Institutions (ANNH)	Tempe, Arizona
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California
Sierra Lobo Inc.	Supporting Organization	Industry Small Disadvantaged Business (SDB)	

## Primary U.S. Work Locations

Arizona	California
Ohio	

## Project Transitions

▶ **August 2016:** Project Start

✓ **August 2018:** Closed out

**Closeout Summary:** Completed laboratory testing including receiver in cryogenic temperature test NCE due to funding delay at JPL. Publications: Jonathan Hoh, Christopher Groppi, Choonsup Lee, Robert Lin, Philip Maukopf, Phil Putman, and Jose Siles, "Integrated Schottky Receiver for Small Satellite Deployment". 29th International Symposium on Space Terahertz Technology, Pasadena, CA March 2018. Jose V. Siles, "Ultra-broadband Submillimeter-wave Receivers for High Spectral Resolution Spectroscopy of Moons and Comets", Invited talk at the 15th Annual Meeting of the Asia Oceania Geosciences Society, Honolulu, Hawaii, June 2018. Jose V. Siles, Jonathan Kawamura, Darren Hayton, Jonathan Hoh, Chris Groppi, Mercedes Herreras, and Imran Mehdi, "An Ultra-Compact 520-600 GHz/1100-1200 GHz Receiver With <10 W Power Consumption For High-Spectral Resolution Spectroscopy From Small-Sat Platforms", Invited keynote talk at the 43rd International Conference on Infrared, Millimeter and THz waves, Nagoya, Japan, September 2018.

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

Arizona State University-Tempe (ASU)

### Responsible Program:

Small Spacecraft Technology

## Project Management

### Program Director:

Christopher E Baker

### Program Manager:

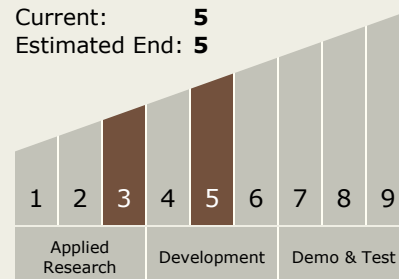
Roger Hunter

### Principal Investigator:

Christopher E Groppi

## Technology Maturity (TRL)

Start: 3  
Current: 5  
Estimated End: 5



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## Project Website:

<https://www.nasa.gov/directorates/spacetech/home/index.html>

## Target Destinations

Earth, Mars, Others Inside the Solar System